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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/717,603	11/21/2003	Vencent Chang	82471X	8213

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EXAMINER	
SULLIVAN, CALEEN O	
ART UNIT	PAPER NUMBER
1756	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	04/17/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/717,603	CHANG ET AL.	
	Examiner	Art Unit	
	Caleen O. Sullivan	1756	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *07 March 2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3-15 and 17-20* is/are pending in the application.

4a) Of the above claim(s) *2 and 16* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,3-15 and 17-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *21 November 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. Applicants amendments have overcome the objections to claims 4-5, 14 and 17 and the rejections of claims 4 and 13 under 35 USC 112 2nd paragraph that were presented in the last Office Action. Examiner has withdrawn the objections and the rejections. However, Applicant's amendments have not overcome the rejections under 35 USC 102(b) and 35 USC 103 (a), presented in the last Office Action. Examiner restates the grounds of rejection presented in the last Office Action in response to the amendments.

2. Note that Examiner has corrected the citation of Saito in the rejections that follow from Saito ('832) to Saito ('320).

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 1, 3-15 and 17-20 are rejected under 35 U.S.C. 102(b) as being anticipated by Saito ('832).

Saito ('320) teaches a method of manufacturing a semiconductor device with a fine pattern formed thereon. The method begins with a step of forming a resist pattern on a semiconductor substrate from a chemically amplified photoresist, by irradiation with a KrF laser, and then forming an organic film layer, which produces acid on exposure to light, on the semiconductor substrate including the photoresist layer. (See, col. 6, 19-23). The method includes a second exposure step, which is followed by a heat treatment that causes the acid produced in the organic film, during the

second exposure step, to diffuse into the chemically amplified resist patterns, and form a soluble layer. (See, col. 6, 24-28 and 32-46). Then, the organic film and the solubilized layer are removed by an alkaline developer, resulting in shrinkage of the resist patterns that were in contact with the exposed portions of the organic film. (See, col. 6, 47-50 and 56-60).

These teachings in Saito ('320) meet the limitations of claims 1 and 7-8, where a substrate is provided on which a photoresist layer is formed and then exposed to form two photoresist regions. Then a chemical diffusion layer is formed. Next, the entire substrate including the photoresist layer and the chemical diffusion layer is baked. During the baking process the chemical material of the second photoresist region and the chemical material of the chemical diffusion layer react with the chemical material of the first photoresist region. After the baking process a developing step takes place, which results in the line width of the first photoresist region shrinking. Although the steps of the method of claim 14 are recited in an order that is different from claim 1, claim 14 uses the open-ended language "comprising;" therefore, the steps do not have to occur in the order recited and the limitations of claims 14 and 18-19 are also taught by the disclosures in Saito ('320).

The heat treatment disclosed in Saito ('320) is conducted between 60°C-140°C, for 1-3 minutes, which is within the temperature and time ranges recited in claims 11 and 13. (See, col. 6, 39-46). Saito ('320) also teaches that if the temperature or the time of the heat treatment is increased the amount of resist pattern dissolved during the development step is also increased, resulting in shrinkage of the line width. (See, col. 6, 39-46). This disclosure teaches the limitations of claims 9 and 20, where the shrinking line width of the first photoresist region depends on the diffusive rate of the first chemical material. (See, col.6 39-46). Moreover, the disclosure meets the limitations recited in claims 10 and 12, where the shrinking line width of the first photoresist region can be

controlled by either the time for baking or by the temperature of the baking process. (See, col.6, 39-46).

Saito ('320) also discloses the organic layer formed on the substrate after the photoresist layer is formed and exposed is a polymer with an acidic component added to it. (See col. 6, 66-col. 7, 2). This disclosure meets the limitation of claims 5 and 17, where the chemical diffusion layer includes a second chemical material. Saito ('320) also discloses acidic components including photosensitive acid generators such as trifluoro-methane sulfonate that can be included in the organic layer. (See col.7, 17-24). The limitation of claim 6 recites the second chemical material of the chemical diffusion layer and the first chemical material, included in the second photoresist region, are the same. Moreover, the acidic components listed in Saito ('320) also teach the limitations of claims 3 and 4, which recite the first chemical material is an acid-based and more specifically a fluorine-based acid material. (See, col.7, 17-24).

Claim 15 recites the chemical diffusion layer that is formed on the photoresist layer is transparent. Although Saito ('320) does not disclose the organic film layer, formed on the photoresist layer is transparent, it is inherent that the layer is transparent since the exposure of the underlying layer occurs through the chemical diffusion layer.

Saito ('320) teaches every limitation of claims 1, 3-15 and 17-20.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. The factual inquiries set forth in *Graham* v. *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

7. Claims 14-15 and 17-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Saito ('320) in view of Wheeler ('525).

Saito ('320) is relied upon as discussed in the rejections of claims 1, 3-15 and 17--20 under 35 USC 102 (b) set forth above in paragraph 6. Saito ('320) fails to disclose a method where the photoresist is contacted with a chemical diffusion layer before the resist layer is exposed to radiation and patterned, which is inferred by claim 14 although the claim language does not recite this ordering. However, a method teaching such an order is disclosed in Wheeler ('525).

Wheeler ('525) teaches a thin layer imaging process for microlithography, which begins with a step of coating a substrate with a layer of resist material that contains a photo acid generator or a photo acid precursor that can generate a photo acid when exposed to light. (See, col.5, 47-52 and Fig. 1). In the next step of the process the resist material is soft baked to remove residual solvent and is exposed to silicon containing environment whereby a layer of silylated resist material is formed. (See, col.6, 23-27 and Fig.2). The silylated resist material is then patterned by passing light through the openings in the mask onto the silylated resist material. (See, col. 6, 51-57 and Fig.3). Next the entire structure is subjected to a post exposure vacuum bake at a temperature of about 120°C, which leaves a resist surface that is composed of silylated and unsilylated regions. (See col. 7,

10-17 and Fig.4). Then the resist material is etched by a conventional etching step such as an Oxygen plasma etch. (See, col.6, 21-26).

The silylation steps disclosed in Wheeler ('525) meet the limitations of claim 14, where a chemical diffusion layer is formed on a substrate, over a layer of photoresist formed on the substrate. Then the substrate including the photoresist layer is exposed through the chemical diffusion layer to form first and second photoresist regions. Next the substrate including the exposed photoresist layer and the chemical diffusion layer is baked and developed.

Although, neither Saito ('320) nor Wheeler ('525) disclose the film layer, formed over the photoresist layer is transparent, it is inherent the layer is transparent since exposure of the underlying layer occurs through this chemical diffusion layer.

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to combine the teachings of Saito ('320) with the teachings of Wheeler ('525) in order to achieve a lithographic method capable of producing submicron features, because Wheeler ('525) teaches that contacting a layer of photoresist with a silicon environment before exposing the photoresist to form patterns, creates areas in the resist material that are more easily removed because they are diffused with a material layer that decreases etch resistance or increases solubility in developer, resulting in a reduced line width of the photoresist regions after development.

Response to Arguments

8. Applicant's arguments filed 03/07/2007 have been fully considered but they are not persuasive.

Applicant argues that Saito ('320) fails to disclose, teach or suggest that a first chemical material is produced within the second photoresist region of the photoresist layer during the exposing process. Although Saito ('320) does not explicitly state a first chemical material is produced

during the exposure, the resist pattern is formed from a chemically amplified resist material that includes a photo acid generator; therefore it is inherent that a first chemical material is produced in the second photoresist region during the exposure process.

Applicant further argues that Saito ('320) fails to disclose, teach or suggest that a first chemical material is diffused into a first photoresist region to react with the material of the first photoresist region. Although Saito ('320) does not explicitly state the acid generated in the exposed portions of the resist layer is diffused into the non-exposed portion of the resist layer it is inherent that since the photo acid generator of the resist material is trifluoro-methane sulfonate, which will produce a fluorine based acid in the exposed region of the resist layer upon exposure, it is inherent that it will diffuse into the unexposed region during the post exposure bake step, just as the fluorine-based acid generated in the second resist region disclosed by applicant.

Applicant further argues that Saito ('320) fails to disclose, teach or suggest that the chemical reaction layer and the second photoresist region are removed together during the developing process. However, Saito ('320) explicitly states that the in the last step of the process, the organic film layer and the solubilized layer are removed by an alkaline developer (See, col6, 47-50, 56-60), and although not explicitly stated it is inherent that if the acid produced diffuses into portions of the non-exposed resist and reacts with this material to become soluble it will be removed during the development step as well.

Saito ('320) does disclose, teach or suggest all the limitations of claims 1, 3-15 and 17-20.

Applicant also argues that Wheeler ('525) fails to discloses, teach or suggest that a first chemical material is produced within the second resist region during the exposing process. Wheeler ('525) is not relied upon in the rejection as teaching this limitation; however, the resist material in Wheeler is a chemically amplified resist material that includes a photo acid generator. Although not

Although not explicitly disclosed in Wheeler ('525) it is inherent that a first chemical material, such as an acid will be generated in the exposed portion of the resist material upon exposure because the resist is a chemically amplified resist film.

Applicant further argues Wheeler ('525) fails to disclose, teach or suggest that a first chemical material is diffused into a first resist region to react with material of the first resist region to form a chemical reaction layer. However, Wheeler ('525) is not relied upon in the rejection as teaching this limitation of claim 14. Wheeler ('525) is relied upon as teaching the limitations of claim 14, where a chemical diffusion layer is formed on a substrate over a layer of resist, which is then exposed through the diffusion layer to form first and second resist regions.

Applicant then argues that Wheeler ('525) fails to disclose, teach or suggest that the chemical reaction layer and the second resist region are removed together during the development process. Wheeler ('525) is not relied upon in the rejection as teaching or suggesting this limitation of claim 14. Wheeler is relied upon as teaching the limitations of claim 14, where a chemical diffusion layer is formed on a substrate over a layer of resist, which is then exposed through the diffusion layer to form first and second resist regions.

Therefore, Saito ('320) in view of Wheeler ('525) does disclose, teach or suggest the limitations of claims 14-15 and 17-20.

9. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on

the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Conclusion

11. The prior art made of record and not relied upon is US Patent No., 6,448,097, which was cited in the rejection of the parent application US 2001/0166447. The teachings in the ('097) reference were not applicable to the claims of the present application.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Caleen O. Sullivan whose telephone number is 571-272-6569. The examiner can normally be reached Monday-Friday, 8:30am-5:00pm. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

COS, 4/6/2007

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